SECTION 16430

POLYPHASE METERING

PART 1 GENERAL

1.1 SECTION INCLUDES

A Multi-function, polyphase digital electrical meter.

B. Test switches.

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Edit C through E to match Project requirements.
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C. Instrument transformers.

D. Meter cabinet.

E. Applications software.

1.2 SUBMITTALS

A. Submit the following in accordance with the requirements of Section 01300:

1. Catalog data and manufacturer's technical data, including data proving that materials comply with specified requirements. Provide catalog sheets showing ratings, dimensions, and enclosure details.

2. Installation instructions indicating application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.

3. Test report for installed meter.

4. Wiring Diagram

5. Operation and maintenance instructions.

1.3 REGULATORY REQUIREMENTS

A. Conform to requirements of ANSI/NFPA 70 - *National Electrical Code*.

B. Furnish products listed and classified by Underwriters Laboratories, Inc., as suitable for purposes specified and shown.

1.4 COORDINATION

Coordinate the features of the meter and associated current transformers and potential transformers with the ratings and characteristics of the supply circuit.

1.5 EXTRA MATERIALS

Furnish one spare for every five installed fuses, but not less than one set of three of each kind.

PART 2 PRODUCTS

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Select <u>one</u> from 2.1 through 2.3 to match Project requirements. Use the meter specified in 2.1 for 208Y/120 V, 480 V, and 480Y/277 V services <u>up to 800 Amps</u>. Use the meter specified in 2.2 for 208Y/120 V, 480 V, and 480Y/277 V services <u>over 800 Amps</u>. Use the meter specified in 2.3 for <u>13.2 kV primary metered services</u>. Use the single phase meter specified in Section 16431 for single phase 120/240 V services up to 200 amps.

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2.1 MULTI-FUNCTION DIGITAL ELECTRICAL METER

A. Provide an addressable microprocessor-based meter. Meter shall be UL 508 Listed.

B. The meter shall sample current and voltage signals at a rate high enough to provide true-RMS metering accurate beyond the 30th harmonic.

C. The meter shall be rated for an operating temperature range of -25 °C to 70 °C and have an overcurrent withstand rating of 500 amps for 1 second.

D. Setup parameters required for the meter shall be stored in non-volatile memory and retained in the event of a control power interruption. Any battery used to provide non-volatile memory must be serviceable from the front of the meter.

E. The meter shall display the following metered values on a faceplate alphanumeric readout and shall auto range between Units, Kilo-Units, and Mega-Units. The information shall be also available at a remote computer through a communications network:

1. Real-Time Readings (accuracy expressed as percent of full scale):

Current:	±0.2% Accuracy, True RMS, Phase A, Phase B, Phase C, Neutral, Ground.
Voltage:	±0.2% Accuracy, True RMS Phase A-B, Phase A-Neutral, Phase B-C, Phase B-Neutral, Phase C-A, Phase C-Neutral.
Real Power:	±0.4% Accuracy, Phase A, Phase B, Phase C, 3-Phase Total.
Reactive Power:	±0.4% Accuracy, Phase A, Phase B, Phase C, 3-Phase Total.
Apparent Power:	±0.4% Accuracy, Phase A, Phase B, Phase C, 3-Phase Total.
Frequency:	±0.01 Hz.
Power Factor:	±1.0% Accuracy, Phase A, Phase B, Phase C, 3-Phase Total.
%THD - Current:	±1.0% Accuracy, Phase A, Phase B, Phase C.
%THD - Voltage:	±1.0% Accuracy, Phase A, Phase B, Phase C.
K-Factor - Current:	±1.0% Accuracy, Phase A, Phase B, Phase C.

2. Energy Readings (accuracy expressed as percent of full scale):

Real Energy:	±0.4% Accuracy, 3-Phase Total
Reactive Energy:	±0.4% Accuracy, 3-Phase Total

3. Demand Readings (accuracy expressed as percent of full scale):

Demand Current:	±0.4% Accuracy, Phase A, Phase B, Phase C, and Neutral, present and peak
Demand Real Power :	±0.4% Accuracy, 3-Phase Total, present and peak.
Demand Apparent Power :	±0.4% Accuracy, 3-Phase Total, present and peak.

F. The meter shall maintain any user selectable combination of the following trend logging information in non-volatile memory. This information shall be available for local downloading though the optical RS-232 port or available at a remote computer through the RS-485 communications port:

1. Eight days of 14 metered values, date and time stamped, user selectable sampling rate, or

2. Maximum and minimum of each metered value with date and time of occurrence, or

3. Peak power demand with date and time of occurrence.

G. Meter shall be programmable to operate up to three Form C (NO/NC) output contacts in response to any user selected combination of the following alarm conditions. Indication of an alarm condition shall also be displayed on the front panel.

1. Phase Loss - Voltage: Selectable percentage and time delay.

2. Phase Loss- Current: Selectable percentage and time delay.

3. Phase Unbalance - Voltage: Selectable percentage and time delay.

4. Phase Unbalance - Current: Selectable percentage and time delay.

5. Voltage Phase Reversal

6. Overvoltage: Per phase, selectable percentage and time delay.

7. Undervoltage: Per phase, selectable percentage and time delay.

H. Provide a field replaceable input/output module with the following ports:

1. One solid-state output suitable for KYZ pulse initiation.

2. Four solid-state status inputs.

3. Three mechanical output relays.

I. The meter shall accept inputs from industry standard instrument transformers.

1. Potential transformer ratios up to 1.2 MV:120 VAC shall be supported.

2. Current transformer ratios up to 32,000:5 A shall be supported.

J. The meter shall operate properly with control power input from 100 to 264 VAC or 100 to 300 VDC.

K. The meter shall be equipped with at least one of the following digital communications ports.

1. A rear mounted RS-485 port that is capable of communicating over a twisted pair network at 19,200 baud.

2. A front mounted RS-232 optical port that is capable of two-way communication with a portable computer through an optical communication interface.

3. A rear mounted RS-232c port that is capable of two-way communications at 19,200 baud.

****
Edit L to match Project requirements.
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L. The meter shall be housed in a [flush] [semi-flush] [surface] mount case.

****
Edit M to match Project requirements. Use the voltage/power module for 480Y/277 V systems that do not already have three 4:1 potential transformers. 480 V delta systems will require two potential transformers as described in paragraph 2.4.
****

M. Provide a voltage/power module to derive potential inputs and control power for the meter when connected to 480Y/277 V systems.

****
Edit N to match Project requirements. Delete voltage/power module if not needed.
****

N. Manufacturer: Square D "Class 3020 Type CM-2150 meter with IOM-44 input/output module and VPM-277-C1 voltage/power module."

****
Match Project requirements. Use 2.2 for 208Y/120 V and 480Y/277 V services <u>over 800 Amps</u>.
****

2.2 MULTI-FUNCTION DIGITAL ELECTRICAL METER

A. Provide an addressable microprocessor-based meter. Meter shall be UL 508 Listed.

B. The meter shall sample current and voltage signals at a rate high enough to provide valid data for waveform analysis and true-RMS metering accurate beyond the 30th harmonic.

C. The meter shall be rated for an operating temperature range of -25 °C to 70 °C and have an overcurrent withstand rating of 500 amps for 1 second.

D. Setup parameters required for the meter shall be stored in non-volatile memory and retained in the event of a control power interruption. Any battery used to provide non-volatile memory must be serviceable from the front of the meter.

E. The meter shall display the following metered values on a faceplate alphanumeric readout and shall auto range between Units, Kilo-Units, and Mega-Units. The information shall be also available at a remote computer through a communications network:

1. Real-Time Readings (accuracy expressed as percent of full scale):

Current:	±0.2% Accuracy, True RMS, Phase A, Phase B, Phase C, Neutral, Ground.
Voltage:	±0.2% Accuracy, True RMS Phase A-B, Phase A-Neutral, Phase B-C, Phase B-Neutral, Phase C-A, Phase C-Neutral.
Real Power:	±0.4% Accuracy, Phase A, Phase B, Phase C, 3-Phase Total.
Reactive Power:	±0.4% Accuracy, Phase A, Phase B, Phase C, 3-Phase Total.
Apparent Power:	±0.4% Accuracy, Phase A, Phase B, Phase C, 3-Phase Total.
Frequency:	±0.01 Hz.
Power Factor:	±1.0% Accuracy, Phase A, Phase B, Phase C, 3-Phase Total.
%THD - Current:	±1.0% Accuracy, Phase A, Phase B, Phase C.
%THD - Voltage:	±1.0% Accuracy, Phase A, Phase B, Phase C.

K-Factor - Current: ±1.0% Accuracy, Phase A, Phase B, Phase C.

2. Energy Readings (accuracy expressed as percent of full scale):

   Real Energy: ±0.4% Accuracy, 3-Phase Total
   Reactive Energy: ±0.4% Accuracy, 3-Phase Total

3. Demand Readings (accuracy expressed as percent of full scale):

   Demand Current: ±0.4% Accuracy, Phase A, Phase B, Phase C, and Neutral, present and peak
   Demand Real Power : ±0.4% Accuracy, 3-Phase Total, present and peak.
   Demand Apparent Power : ±0.4% Accuracy, 3-Phase Total, present and peak.

F. The meter shall maintain any user selectable combination of the following information in non-volatile memory. This information shall be available for local downloading though the optical RS-232 port or available at a remote computer through the RS-485 communications port:

1. Waveform Capture: 20 captures of 4 cycles of all current and voltage inputs, sampled 64 times per cycle, internally or externally triggered.

2. Event Capture: 56-Cycles of all current and voltage inputs, internally or externally triggered.

3. Trend Logging: 40 days of 14 metered values, date and time stamped, user selectable sampling rate, or

   Maximum and minimum of each metered value with date and time of occurrence, or

   Peak power demand with date and time of occurrence.

G. Meter shall be programmable to operate up to three Form C (NO/NC) output contacts in response to any user selected combination of the following alarm conditions. Indication of an alarm condition shall also be displayed on the front panel.

1. Phase Loss - Voltage: Selectable percentage and time delay.

2. Phase Loss- Current: Selectable percentage and time delay.

3. Phase Unbalance - Voltage: Selectable percentage and time delay.

4. Phase Unbalance - Current: Selectable percentage and time delay.

5. Voltage Phase Reversal

6. Overvoltage: Per phase, selectable percentage and time delay.

7. Undervoltage: Per phase, selectable percentage and time delay.

H. Provide a field replaceable input/output module with the following ports:

1. One solid-state output suitable for KYZ pulse initiation.

2. Four solid-state status inputs.

3. Three mechanical output relays.

I. The meter shall accept inputs from industry standard instrument transformers.

1. Potential transformer ratios up to 1.2 MV:120 VAC shall be supported.

2. Current transformer ratios up to 32,000:5 A shall be supported.

J. The meter shall operate properly with control power input from 100 to 264 VAC or 100 to 300 VDC.

K. The meter shall be equipped with at least one of the following digital communications ports.

1. A rear mounted RS-485 port that is capable of communicating over a twisted pair network at 19,200 baud.

2. A front mounted RS-232 optical port that is capable of two-way communication with a portable computer through an optical communication interface.

3. A rear mounted RS-232c port that is capable of two-way communications at 19,200 baud.

****
Edit L to match Project requirements.
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L. The meter shall be housed in a [flush] [semi-flush] [surface] mount case.

****
Edit M to match Project requirements. Use the voltage/power module for 480Y/277 V systems that do not already have three 4:1 potential transformers. 480 V delta systems will require two potential transformers as described in paragraph 2.4.
****

M. Provide a voltage/power module to derive potential inputs and control power for the meter when connected to 480Y/277 V systems.

****
Edit N to match Project requirements. Delete voltage/power module if not needed.
****

N. Manufacturer: Square D “Class 3020 Type CM-2350 meter with IOM-44 input/output module and VPM-277-C1 voltage/power module.”

****
Match Project requirements. Use 2.3 for <u>13.8 kV primary metered services</u>.
****

2.3 MULTI-FUNCTION DIGITAL ELECTRICAL METER

A. Provide an addressable microprocessor-based meter. Meter shall be UL 508 Listed.

B. The meter shall sample current and voltage signals at a rate high enough to provide true-RMS metering accurate beyond the 30th harmonic.

C. The meter shall be rated for an operating temperature range of -25 °C to 70 °C and have an overcurrent withstand rating of 500 amps for 1 second.

D. Setup parameters required for the meter shall be stored in non-volatile memory and retained in the event of a control power interruption. Any battery used to provide non-volatile memory must be serviceable from the front of the meter.

E. The meter shall display the following metered values on a faceplate alphanumeric readout and shall auto range between Units, Kilo-Units, and Mega-Units. The information shall be also available at a remote computer through a communications network:

1. Real-Time Readings (accuracy expressed as percent of full scale):

Current:	±0.2% Accuracy, True RMS, Phase A, Phase B, Phase C.
Voltage:	±0.2% Accuracy, True RMS Phase A-B, Phase B-C, Phase C-A.
Real Power:	±0.4% Accuracy, Phase A, Phase B, Phase C, 3-Phase Total.
Reactive Power:	±0.4% Accuracy, Phase A, Phase B, Phase C, 3-Phase Total.
Apparent Power:	±0.4% Accuracy, Phase A, Phase B, Phase C, 3-Phase Total.
Frequency:	±0.01 Hz.
Power Factor:	±1.0% Accuracy, Phase A, Phase B, Phase C, 3-Phase Total.
%THD - Current:	±1.0% Accuracy, Phase A, Phase B, Phase C.
%THD - Voltage:	±1.0% Accuracy, Phase A, Phase B, Phase C.
K-Factor - Current:	±1.0% Accuracy, Phase A, Phase B, Phase C.

2. Energy Readings (accuracy expressed as percent of full scale):

Real Energy: ±0.4% Accuracy, 3-Phase Total
Reactive Energy: ±0.4% Accuracy, 3-Phase Total

3. Demand Readings (accuracy expressed as percent of full scale):

Demand Current: ±0.4% Accuracy, Phase A, Phase B, Phase C, present and peak
Demand Real
Power : ±0.4% Accuracy, 3-Phase Total, present and peak.
Demand Apparent
Power : ±0.4% Accuracy, 3-Phase Total, present and peak.

F. The meter shall maintain any user selectable combination of the following trend logging in non-volatile memory. This information shall be available for local downloading though the optical RS-232 port or available at a remote computer through the RS-485 communications port:

1. Eight days of 14 metered values, date and time stamped, user selectable sampling rate, or

2. Maximum and minimum of each metered value with date and time of occurrence, or

3. Peak power demand with date and time of occurrence.

G. Meter shall be programmable to operate up to three Form C (NO/NC) output contacts in response to any user selected combination of the following alarm conditions. Indication of an alarm condition shall also be displayed on the front panel.

1. Phase Loss - Voltage: Selectable percentage and time delay.

2. Phase Loss- Current: Selectable percentage and time delay.

3. Phase Unbalance - Voltage: Selectable percentage and time delay.

4. Phase Unbalance - Current: Selectable percentage and time delay.

5. Voltage Phase Reversal

6. Overvoltage: Per phase, selectable percentage and time delay.

7. Undervoltage: Per phase, selectable percentage and time delay.

H. Provide a field replaceable input/output module with the following ports:

1. One solid-state output suitable for KYZ pulse initiation.

2. Four solid-state status inputs.

3. Three mechanical output relays.

I. The meter shall accept inputs from industry standard instrument transformers.

1. Potential transformer ratios up to 1.2 MV:120 VAC shall be supported.

2. Current transformer ratios up to 32,000:5 A shall be supported.

J. The meter shall operate properly with control power input from 100 to 264 VAC or 100 to 300 VDC.

K. The meter shall be equipped with at least one of the following digital communications ports.

1. A rear mounted RS-485 port that is capable of communicating over a twisted pair network at 19,200 baud.

2. A front mounted RS-232 optical port that is capable of two-way communication with a portable computer through an optical communication interface.

3. A rear mounted RS-232c port that is capable of two-way communications at 19,200 baud.

****
Edit L to match Project requirements.
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L. The meter shall be housed in a [flush] [semi-flush] [surface] mount case.

M. Manufacturer: Square D “Class 3020 Type CM-2150 meter with IOM-44 input/output module,”

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Edit 2.4 to match Project requirements. Adequate instrument transformers may be existing in retrofit applications.
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2.4 INSTRUMENT TRANSFORMERS

A. Provide current transformers and potential transformers, conforming to ANSI C57.13, metering accuracy class 0.3, of suitable ratio and burden for specified metering.

B. Provide current transformers having 5 Amp secondaries and a continuous current rating factor of not less than 2.0.

1. Provide two current transformers for 3-phase, 3-wire delta circuits. Select current transformer primary to match circuit overcurrent device trip rating.

2. Provide three current transformers for 3-phase, 4-wire wye circuits. Select current transformer primary to match circuit overcurrent device trip rating.

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Edit 3 to match Project requirements. Only the meter in 2.2 will require a neutral CT.
****

3. Provide a neutral current transformer for low voltage 3-phase, 4-wire wye circuits 201 amperes and greater. Select current transformer primary to be approximately 50% of the circuit overcurrent device trip rating.

4. Current transformers for low voltage circuits (600 V and less) shall have 10 kV BIL. Current transformers for 13.8 kV circuits shall have 110 kV BIL.

****
Edit 5 to match Project requirements. Select CT to match system voltage and current.
****

5. Manufacturer: Westinghouse
Type CMS, through 200:5 at 600 V or less.
Type CMF, through 1000:5 at 600 V or less.
Type CLC, through 2000:5 at 600 V or less.
Type CLE, through 3000:5 at 600 V or less.
Type KIR-11, indoors at 13.8 kV .
Type KON-11, outdoors at 13.8 kV.

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Edit C to match Project requirements. The meters in 2.1 and 2.2 will not require potential transformers connected to 480Y/277 V system.
****

C. Provide potential transformers having 120 VAC secondaries and ANSI C57.13 metering accuracy Class: 0.3 for W, X, M and Y burdens.

1. Provide two potential transformers for 3-phase, 3-wire delta circuits. Select potential transformer primary to match system line-to-line voltage.

2. Provide three potential transformers for 3-phase, 4-wire wye circuits. Select potential transformer primary to match system line-to-line voltage.

3. Potential transformers for low voltage circuits (600 V and less) shall have 10 kV BIL. Potential transformers for 13.8 kV circuits shall have 110 kV BIL.

****
Edit 4 to match Project requirements. Select PT to match system voltage.
****

4. Manufacturer: Westinghouse
Type VIZ-11 with 2 primary fuses for 13.8 kV system indoors
Type VOY-11 for 13.8 kV system outdoors
Type PPM for 480 V system

2.5 TEST SWITCHES AND PLUGS

A. Provide semi-flush mounted test switches in meter potential and current circuits to facilitate testing of the meter installation and also external connection of additional portable metering equipment.

B. Test switch shall automatically short circuit current transformer circuits when the knife switches are opened preparatory to inserting the test plug.

C. Test switch shall have potential and shorting type current poles as follows:

1. 3 wire delta systems: 3 potential poles and 4 shorting type current poles.

2. 4 wire wye systems: 4 potential poles and 6 shorting type current poles.

3. 4 wire wye systems with metered neutral: 4 potential poles and 8 shorting type current poles.

D. Provide matching test plugs designed for in-service testing.

E. Manufacturers: Westinghouse “Type FT-1” or States “Type SMH”.

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Edit 2.6 to match Project requirements. Delete B and D on 480 V systems.
****

2.6 POTENTIAL CIRCUIT FUSES

A. Provide UL Class CC, fast-acting, 600 V fuses to protect each potential lead to the meter and to protect the primary of each 480:120 VAC potential transformer.

1. Provide 1 Amp fuses to protect each potential lead to the meter.

2. Provide 2 Amp fuses to protect the primary of each 480:120 VAC potential transformer.

3. Provide each fuse with a cover having a blown-fuse indicator.

4. Manufacturer: Bussman “Type KTK-R fuses, Class CC fuseblocks, and SAMI fuse covers.”

B. For indoor medium-voltage metering installations, protect the primary of each potential transformer with indoor, current-limiting, 1/2 Amp, 14,400 V fuses having blown fuse indication. Manufacturer: Westinghouse, “Type CLE-PT IND”, or S&C “Fusistor.”

C. For outdoor medium-voltage metering installations, protect the primary of each potential transformer with outdoor, 1 Amp, 14,400 V power fuses. Manufacturer: S&C ”SMD-20 with SMU-20 fuse unit”,

2.7 WIRING AND TERMINATIONS

A. Refer to Section 16120 - BUILDING WIRE AND CABLE for materials and color coding.

B. Use No. 10 AWG, Type THHN-THWN, stranded copper, for current transformer secondary circuits.

C. Use No. 12 AWG, Type THHN-THWN, stranded copper, for potential transformer secondary circuits.

D. Use crimp-on, nylon insulated, insulation grip, brazed seam terminals for instrument wiring as follows:

1. Use ring tongue terminals for nutted studs. Manufacturer: Burndy “Type TN”

2. Use flanged fork terminals for barrier terminal strips. Manufacturer: Burndy “type YAE-Z”

3. Use pin terminals for DIN type terminal blocks. Manufacturer: 3M type “MNG-P”.

****
Edit 2.8 to match Project requirements. Use meter cabinet for retrofit applications or where there is insufficient space to mount the meter and test switches in the switchgear. Approximate size of cabinet required is 24" X 20" x 10", but this should be verified.
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2.8 METER CABINET

A. Provide a metal cabinet with hinged door to house the meter, test switches, fuse blocks, and terminal strips. Allow sufficient space in cabinet for future installation of a telephone modem or Ethernet gateway with dimensions of 5" x 10" x 8".

B. [Provide a NEMA 3R cabinet for outdoor installation.] [Provide a NEMA 12 cabinet for indoor installation.]

C. Provide a swing-out panel mounted behind the cabinet door for mounting the meter and test switches.

D. Provide ground lug mounted to the inside of the cabinet, and flexible ground straps for bonding the swing-out panel to the cabinet.

E. Manufacturer: Hoffman

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Edit 2.9 to match project requirements. Only one optical communications interface device per FMU is justifiable.
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2.9 OPTICAL COMMUNICATIONS INTERFACE

A. Provide an optical communications interface device to connect the serial port of a portable computer to the front panel optical RS-232 port on the meter.

B. Manufacturer: Square D “Class 3090, Type OCI-2000.”

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Edit 2.10 to match project requirements. Only one set of applications software per FMU is justifiable.
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2.10 APPLICATIONS SOFTWARE

A. Provide application software to download and display metered data, recorded events, and captured waveforms to a portable computer through an optical communications interface.

B. Application software shall operate in a Microsoft Windows environment.

C. Software shall support an unlimited number of individual devices, polled one at a time.

D. Software shall provide the following capabilities when connected to a meter with the corresponding data collection capabilities.:

1. Display instantaneous data tables.

2. Display instantaneous bar charts.

3. Display graphical analog meters.

4. Display digital status inputs.

5. Digital and analog alarms.

6. Event recording.

7. Data logging in a standard file format.

8. Display historical tables.

9. Export historical data to other file types.

10. Display historical trend plots.

11. Output data logging to printer.

12. Display voltage and current waveform captures.

13. Calculate and display residual current.

14. Export captured waveforms for harmonic analysis.

15. Context sensitive help system.

16. Report generation.

E. By entering appropriate passwords, operator shall be able to configure the addressable microprocessor-based meter through the applications software.

F. Manufacturer: Square D “Class 3080, Type SMS-121.”

PART 3 EXECUTION

3.1 INSTALLATION

A. Install metering equipment where indicated on the Drawings and according to manufacturer's instructions.

B. Mount with meter readout approximately 5 feet above the floor. Install meter and enclosure plumb. Provide supports according to Section 16190 Electrical Supporting Devices.

C. Provide sufficient space adjacent to the metering equipment for future installation of a telephone modem or Ethernet gateway with dimensions of 5" x 10" x 8".

D. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. Where manufacturer's torque values are not furnished, use those specified in UL 486A.

E. Ground meter and enclosure according to manufacturer’s instructions and requirements in Section 16450 - Secondary Grounding.

F. Connect meter to derive control power from the potential circuit in accordance with manufacturer’s instructions.

G. Wire current and potential leads through test switch. Use shorting switches for the current transformer leads.

H. Follow manufacturer’s instructions to setup meter to match electrical system and instrument transformer characteristics.

I. Identify meter, test switches, and instrument wiring according to Section 16195 - Electrical Identification.

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Edit J. to match project requirements.
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J. Deliver optical communications interface and applications software to [Contract Administrator] [Project Leader] [Facility Manager].

3.2 FIELD QUALITY CONTROL

A. Inspect accessible components for cleanliness, mechanical, and electrical integrity, and for presence of damage or deterioration before energizing.

B. Verify proper fuses are installed for meter potential circuits.

C. Using separate calibrated meters, verify correct connection, setup, and functioning of each meter function. Submit test report.

D. After completing installation, cleaning, and testing, touch up scratches and mars on finish to match original finish.

END OF SECTION